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April 2014

CC206 Feedlot Pollution

Tom Leisy

Deon D. Axthelm

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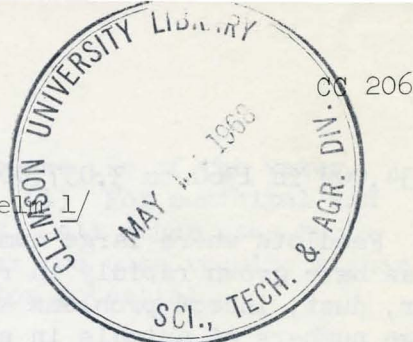
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Feedlot Pollution

by
Tom D. Leisy and Deon D. Axthelm 1/



The Problem

Water is a prime requirement for the existence of man. It is necessary for all phases of domestic use, for industrial development and for agricultural progress.

Our ability to successfully use and manage our water resources will be a determining factor in the future progress of our nation.

Sewage and other waste disposal has always been a problem in heavily populated areas but only recently has the gravity of the situation been recognized.

The extent of water pollution can be determined by several methods. While the killing of fish is only one of the damages of water pollution, it is one of the more easily observed. Results indicate the extent of pollution.

Raw domestic sewage accounted for the direct death of over 23,000 fish in Nebraska in 1966. Kansas reported 27 pollution-caused fish kills in 1964, 15 of which were attributed to commercial feedlots.

The continuing increase in pollution of water has resulted in legislation at both Federal and State level. The laws are designed not only to stop the degradation of our rivers, streams and ground water, but also to enhance the quality of those waters. To abide by recent legislation, industry and municipalities are attempting to control or treat wastes before they are emptied into the waterways; however, they are not the only sources of pollution to our rivers and streams. Nebraska's ground and surface water is also threatened by pollutants from feedlots.

Pollution from all sources can be a potential menace to public health and welfare, may harm wildlife, fish and aquatic life and may impair domestic, agricultural, industrial and recreational uses of water.

Pollution may be defined as "any change imposed upon the character of water adversely affecting its usefulness." Describing pollution in this manner shows that some water may be polluted as far as drinking quality is concerned but may not be polluted as far as fishing is concerned; some water may be polluted as far as maintaining fish population, but not polluted for agriculture and so on.

The nature of animal production has made a marked change in the last decade. Specialized, large scale livestock production has introduced new problems and challenges. Cattle marketed in Nebraska have increased from

1/ Tom D. Leisy, County Agricultural Extension Agent, Chairman, Washington County.
Deon D. Axthelm, Agricultural Extension Water Resources Specialist, Ag
Engineering Department.

1,434,000 in 1960 to 3,057,000 in 1967.

Feedlots where large numbers of cattle are confined in relatively small areas have grown rapidly in recent years. Confinement feeding has increased odor, dust, insect problems and water pollution potential. Concentration of large numbers of animals in small areas means that it is no longer possible for livestock wastes to be dropped on pastures where they are absorbed by the environment without creating nuisance conditions. Thus, controlling feedlot wastes becomes a greater problem.

Complaints of extreme pollution have been registered by citizens living downstream from Nebraska feedlots.

Feedlot operators not only have an obligation to lawfully control runoff but also have a responsibility to do their part in helping conserve our natural resources.

Nebraska Law

Recognizing the seriousness of the pollution problems, Legislative Bill 360 was enacted in 1967, amending and updating a previous water pollution bill. Originally, the law was concerned mostly with municipality and domestic wastes; now the law is more inclusive, with broader powers given to the Nebraska Water Pollution Control Council. The Council is composed of four state agency members and six others appointed by the Governor.

A state-wide committee of Nebraska Livestock Feeders and representatives of the University of Nebraska are working closely with the Council on a feedlot pollution control program that would be equitable to all concerned.

Provisions of LB 360

1. This law provides that the Nebraska Water Pollution Control Council:

- (a) Administrate and enforce the law
- (b) Adopt water-quality standards
- (c) Set up rules and regulations
- (d) Conduct hearings
- (e) Inspect disposal facilities
- (f) Make periodic checks of rivers and streams

2. The law prohibits:

- (a) Discharging wastes causing pollution
- (b) Constructing disposal systems without Council approval
- (c) Increasing operations without Council approval
- (d) Increasing discharge of wastes without Council approval

3. Penalties for violation of the law or regulation are:

- (a) Not less than \$100 or more than \$500
- (b) \$10 per day for each day of violation

The Nebraska Water Quality Standards will be used as a guide or measuring stick to determine if and to what extent pollution has occurred in any given stream.

The standards will differ slightly according to the use of the water. Water is classified according to use in three ways: (1) For municipal and domestic uses; (2) For body contact sports; and (3) All other uses such as agriculture, industrial, etc. Normally, the first two uses require higher standards and, therefore, greater control of pollution potential.

Under these standards, wastes shall not degrade water below certain limits. Pollutants such as taste and odor producing substances, suspended or settleable solids, total dissolved solids, coliform organisms and toxic substances can only be present in specified amounts. These amounts vary for each class of water. In addition, there are limitations on water temperature increase. Oxygen must be present at specified levels and no offensive colors, odors, etc., are permitted.

The Nebraska Water Quality Standards may be obtained from the Nebraska Water Pollution Control Council, State Capitol Building, Lincoln, Nebraska, 68509.

Registration

To help the Council in this huge task of pollution control, feedlot operators who qualify under the Council regulations are required to register their feeding operation with the Water Pollution Control Council before July 1, 1968. The operator of a proposed feedlot which will begin operation after July 1, 1968, must register with the Water Pollution Control Council at least 60 days before beginning construction of any such feedlot operation.

The Nebraska Water Pollution Control Council regulations state that a feedlot operator must register his operation with the Council if the maximum number of animals in confinement at any one time is:

- (1) 300 or more feeder or fat cattle
- (2) 100 or more beef cows
- (3) 100 or more dairy cattle
- (4) 500 or more swine
- (5) 2,000 or more sheep
- (6) 3,000 or more turkeys
- (7) 10,000 or more chickens, ducks or geese

Feedlots smaller than the above mentioned, located within five hundred feet of any watercourse, or any confinement of animals that has a water pollution potential, must register.

A watercourse is any depression or draw 2 feet below the surrounding land and having a continuous outlet to a stream of water, or river, or brook. To be a watercourse, there must be a stream in fact as distinguished from mere surface drainage. Furthermore, to be a watercourse, the depression must have an outlet into a stream. A draw, although 2 feet deep where it enters land, does

not continue to be a watercourse where it flattens out and water runs wherever gravity will take it.

Any feedlot operator who elects to register may do so regardless of the size of his operation or location.

Penalties

Water pollution laws are not discriminatory. They include pollution control of all domestic, municipal, industrial and agricultural wastes. Therefore, any feedlot operator who is, in any way, contributing to the pollution of the streams of this state will come under the provisions of the act regardless of the size or type of his operations.

The Council has the authority and responsibility to check streams and creeks in any part of the State to determine whether they meet the State's water quality standards. Any person who violates any provision of LB 360 or who violates any order or regulation of the Nebraska Water Pollution Control Council shall, upon conviction, be fined not less than one hundred dollars nor more than five hundred dollars and may be further fined ten dollars a day for each day he is in violation.

What Livestock Feeders Are Doing

There are currently several livestock waste disposal systems in operation in the Midwest. Until adequate research is completed, no recommendation favoring one system over another can be made. However, a knowledge of what other feedlot operators are doing may shed some light on a possible approach to some of the waste disposal problems.

This section will briefly describe some of the systems used in handling feedlot wastes. Feedlot operators are cautioned again that this bulletin in no way suggests that one method is superior to another. It is imperative that feedlot operators keep themselves up to date on the latest developments in feedlot disposal systems. Proper planning for future expansion is also a must.

Disposal Systems

Detention Pond. Many feedlot operators have turned to a detention pond as a runoff control device. Of the pollution control systems presently in operation, the detention pond or a variation of this method is probably the most common.

As the name implies, this system detains the runoff until it can be disposed of. The detention pond is usually constructed from earth and, in some cases, will require a soil sealer to prevent leaching.

In a detention pond, the solids will settle out and usually very little decomposition or bacterial digestion will occur. Thus, solids will eventually accumulate and will have to be disposed of.

The frequency of disposing of both the solids and the liquids will depend on the size of pond and the number of cattle in the yard. According to present thinking, the pond should be at least large enough to hold a three or four inch

runoff from the yard. Times of high rainfall may cause many ponds to overflow, sending the pollution runoff directly into the streams and rivers.

Disposal can generally be made in one of two ways. The material can be pumped into "honey wagons" and spread on the land, or it can be pumped through an irrigation system using gated pipe or special sprinkler equipment. In either case, feeders who are experimenting with this method are hoping to dispose of the suspended solids as well as the liquids through these disposal systems. Most of the systems are agitated in some way before pumping to get as many solids into suspension as possible.

The cost of a detention pond will vary depending on size, location in respect to feedlots, the lay of the land and local area costs. It may be more economical for a large feeder to have several small ponds, each draining a specific area instead of one large pond.

Settling Basin. Another system that has been used in combination with the detention pond is the settling basin.

A settling basin is a small, shallow (two to four foot deep) detention pond that will allow the solids to settle out before reaching the larger detention pond. The basin could be constructed of concrete or partly of concrete so that the solids could easily be cleaned out with a tractor and loader.

The settling basin will prevent most of the solids from entering the large detention pond and thus prevent a rapid buildup of solids that will greatly decrease the holding capacity of the pond. It is estimated that this will reduce the loading of a pond or lagoon by as much as 75 percent.

If land is available and the terrain permits, a long, wide, nearly flat waterway catching all the runoff from the yards will serve as a settling basin. This will tend to make the runoff flow at a slow rate. The solids are then deposited on the waterway instead of in the pond.

In some cases it might be feasible to drain the settling basin into a tank for field spreading. The frequency with which the tank must be emptied will depend upon its size and its daily loading rate.

According to Harry J. Eby, Agricultural Engineer with the Agricultural Research Service, Beltsville, Maryland, the approximate average daily loading rate for beef cattle is six gallons per day per animal.

Eby recommends that a settling basin have a capacity of ten times the daily loading rate or 60 gallons per head; that is, if the total daily volume of wastes and runoff water is 300 gallons, a holding basin of 3,000 gallons should be installed.

Lagoon. A lagoon differs from a detention pond in that it uses bacterial action to digest or decompose the solids.

A true lagoon system requires a high degree of management if it is to operate efficiently and effectively. To have maximum bacterial decomposition, large surface areas of water are required. The type of bacterial action (aerobic or anaerobic) is determined by the amount of material being emptied into the lagoon and by the depth of the lagoon.

The shallow lagoon (four to five feet) should operate aerobically (bacteria use oxygen in digestion process). This produces practically no odor; however, this system is prohibitive to the large cattle feeder because of the large surface area required for its successful operation. A great amount of water is required to assure complete aerobic operation. Small lagoons may be easily overloaded with wastes. When conditions governing aerobic decomposition are exceeded the process changes from aerobic to anerobic.

Anaerobic decomposition (digestion without the use of oxygen) occurs in lagoons from about 6 to 15 feet in depth or occurs if oxygen is not available. This process, however, gives off an undesirable odor.

In general, two or three small lagoons joined in series are more efficient than one large lagoon of the same surface area.

Equipment

There are special pumps on the market today designed for lifting slurry. It would be advisable to make a detailed study of equipment available before purchasing. A good pump is a key factor in the successful operation of the system.

The type of pump that may be needed to remove manure and liquids will depend upon the type of storage used. Pumps that are submerged will not need to be primed; however, there are several good self-priming pumps available that can be used above liquid level.

The openings of the pump inlet and the impeller should be large enough to pass three to four inch diameter wastes. A chopping blade at the pump inlet for reducing size of solids is a good feature.

The capacity of the pump should be great enough to permit rapid filling of hauling and spreading tanks. If pipe and sprinkler distribution systems are used, the capacity and the pressures created should be ample to meet requirements.

Proper lubrication of bearings should be assured. The bearings, working parts and the case and mountings should be sufficiently sturdy to resist the corrosive qualities of animal wastes.

If small holding tanks or pits are used, a method of jetting liquids or other means of agitation to hold solids in suspension may be needed.

Check power requirements for the pump to see if it will match power supply.

Means of distribution of waste will also need to be considered. There are several types of tank wagon spreaders, "honey wagons," on the market. Select the type of wagon according to the system's needs and to the loading pump.

Many kinds of sprinklers are available commercially. Usually a single high volume, high pressure specially designed nozzle with a large discharge orifice is advisable. High pressure pumps will be needed for sprinkling liquid manure wastes. The pump and sprinkler system should be engineered to meet the conditions.



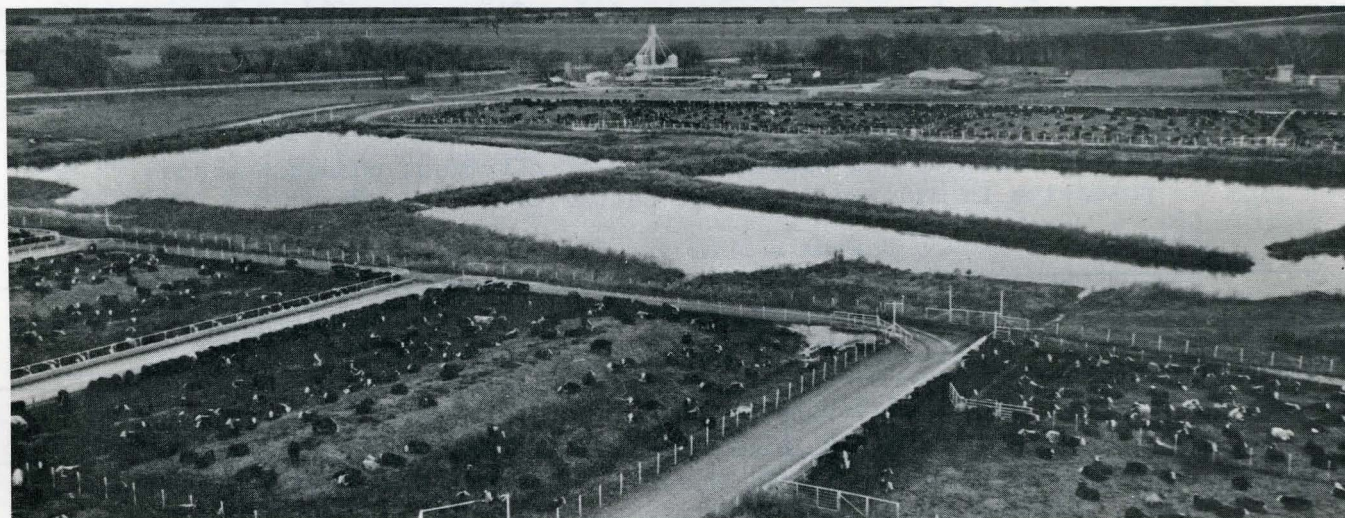
Detention pond--This pond detains runoff from 5,400 head. Pond covers about three acres and cost approximately \$1.50 per head.



Settling basin--This long, wide, flat waterway widens as it approaches the detention pond. If constructed carefully, it should serve several years before cleaning is necessary.



Scraping--Yards may be scraped by a tractor with blade or with a patrol. Note dividing yard fences are on ridges to prevent drainage from one yard to another.



Lagoons--This system was built as a series of aerobic lagoons but too much runoff from the yards caused overloading. As a result the lagoons began operating as anaerobic units. Cost of the system, including land leveling for the yards, was \$2.40 per head.

Management Important

Whatever disposal sytem is chosen, management becomes the key to the successful operation of that unit.

A diversion terrace is necessary to keep all unnecessary drainage above the feedlot from emptying into the system. Runoff from the farm or farm yard and other fields should be diverted to other water drainways. Only the runoff from feedlots should empty into the waste disposal system. Properly diverting outside water will greatly increase the life of the system.

It is recommended that this type of terrace be used in combination with any disposal system.

Scraping feedlots periodically is another good management practice. The scrapings should be hauled away and, preferably, spread on fields - or they may be piled in a central location until time and weather permit hauling to the fields. In both cases provision should be made to prevent runoff from areas involved from entering streams. The more manure that can be spread on a field, the less solids will end up in the disposal system.

If possible, each yard should be designed so that it drains directly to the disposal system or a waterway leading to the system and not through another yard to reach the disposal system.

The following tables may be helpful in planning disposal systems.

Table 1. Average daily and monthly manure production for different size beef animals (Feces and urine only - no bedding) 1/

Weight	Percent		Pounds		Gallons		Cubic Feet	
	Feces - Urine		Day - 30 days		Day - 30 days		Day - 30 days	
1400	70	30	90	2,700	11.3	340	1.5	45
1000	70	30	64	1,920	7.5	225	1.0	30
750	70	30	48	1,440	5.6	170	.75	23

1/ From Information Series No. 150, Robert L. Maddes, Extension Agricultural Engineer, Michigan State University.

Table 2. Average amounts and combined value of nitrogen, phosphorus and potassium in manures from beef cattle.1/

Percent water	Pounds Per Ton of Manure			Value Per Ton
	Nitrogen	Phosphorus	Potassium	
80	14.0	4.0	9.0	\$3.61

1/ From Information Series No. 150, Robert L. Maddes, Extension Agricultural Engineer, Michigan State University.